



Design Partners for the  
Global Aerospace & Defense Industry

# CIRCOR International Overview

## Energy



### Key Markets

- Oil & Gas
- Natural Gas
- Power Generation

### Major Locations

- U.S.A
- Canada
- UK
- Italy
- Germany
- China
- India
- Brazil

## Aerospace & Defense



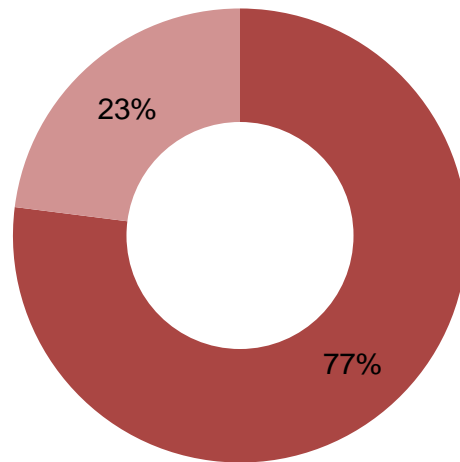
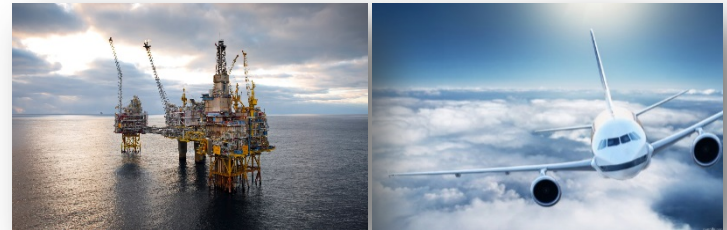
- Commercial Transport
- Business Aviation
- Defense

- U.S.A
- UK
- France
- Morocco
- China
- India

# CIRCOR Business Overview

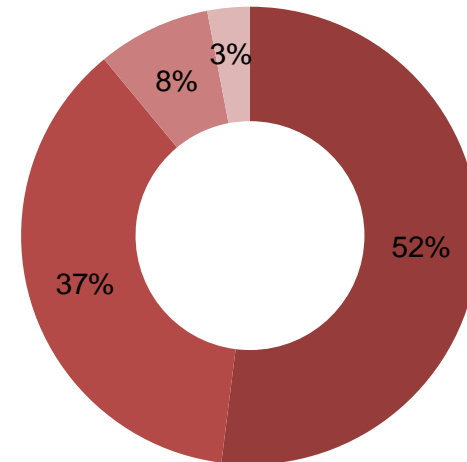
**Business Description:** Design, develop, manufacture and sell flow control and actuation solutions to the Energy (Oil & Gas and Power) and Aerospace markets

2014 Sales: \$841 Million  
Enterprise Value: ~\$1.34 Billion  
Employees: ~3,000  
HQ: Burlington, MA, USA  
NYSE Listed: Ticker: CIR



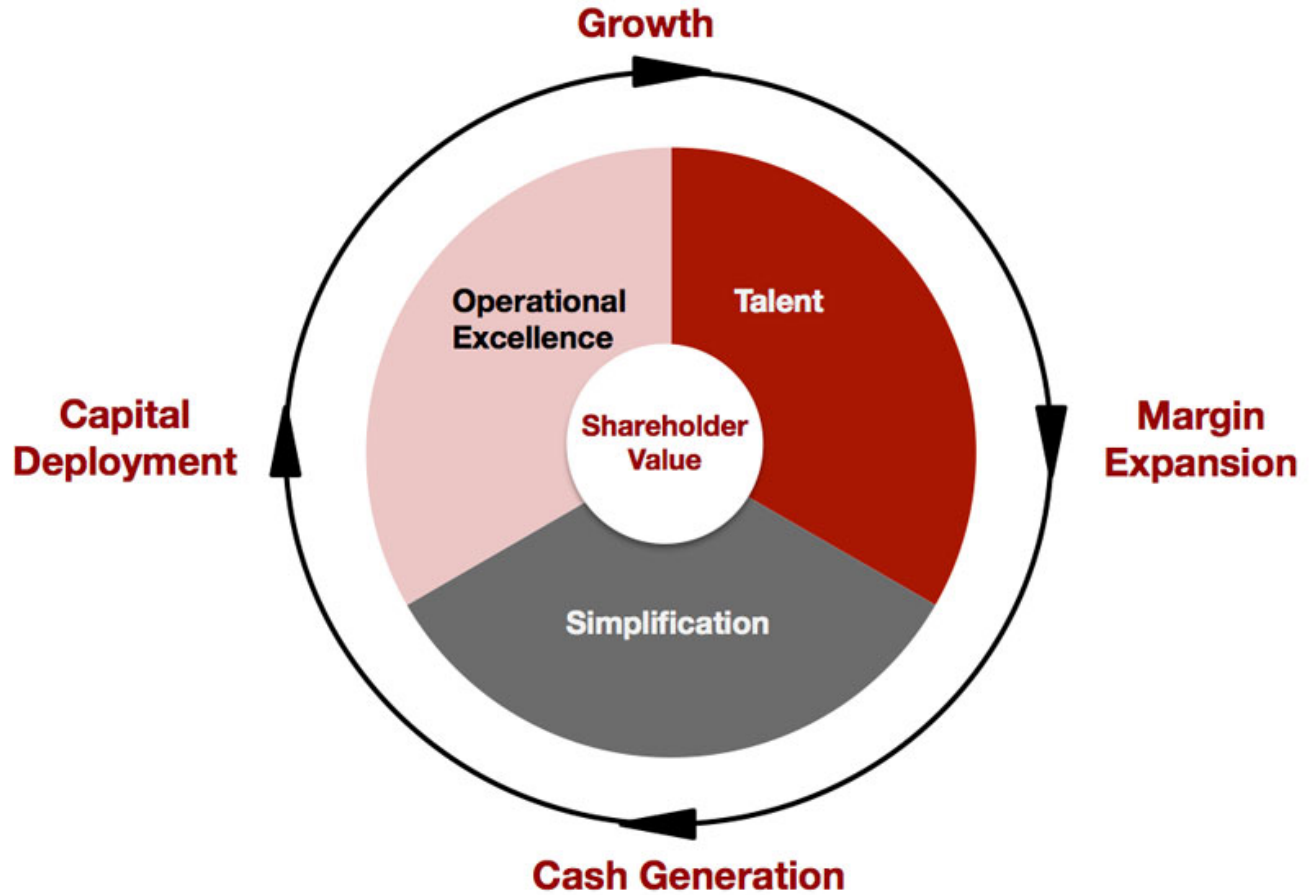
■ Energy ■ Aerospace & Defense

Sales by Geography 2014



■ NA ■ EMEA ■ Asia ■ LA

# CIRCOR's Priorities



# About CIRCOR Aerospace & Defense

**Design, develop and test Fluid Control and Actuation products for commercial and defense markets**

**Focused on high growth programs and technologies**

- Commercial aircraft
- Weapons & Ordnance
- Aftermarket, Maintenance, Repair and Overhaul

**Strong, globally recognized brands with differentiated technology**

- Aerodyne pneumatic controls
- CIRCOR Bodet sensing & flight controls
- Circle Seal electromechanical valves
- Hale Hamilton air control valves

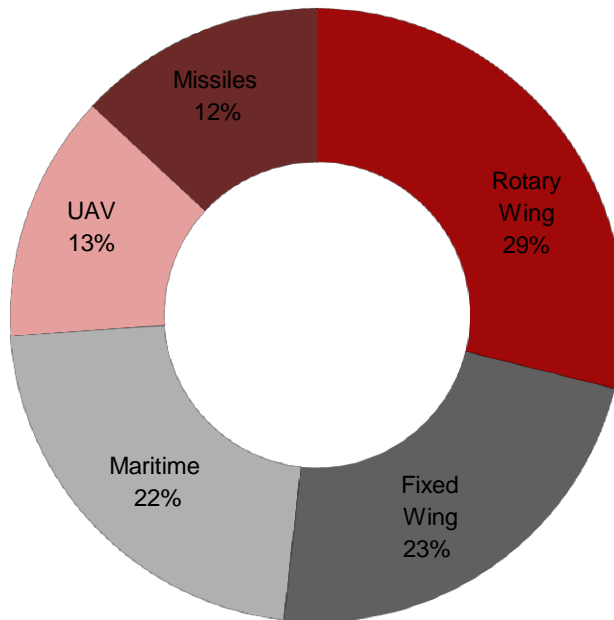
**International footprint for growth and low cost manufacturing**



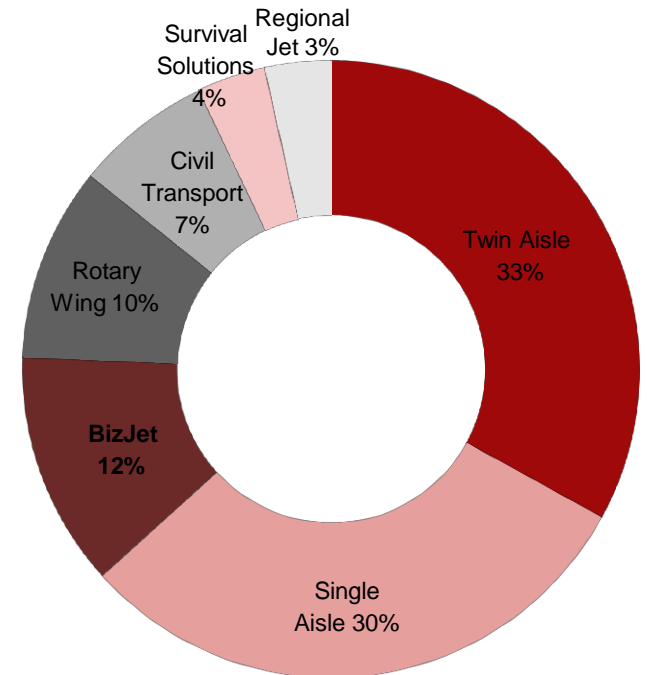
# Balanced Business

2013 Aerospace & Defense Sales = \$199M

## Defense 60%



## Commercial 40%

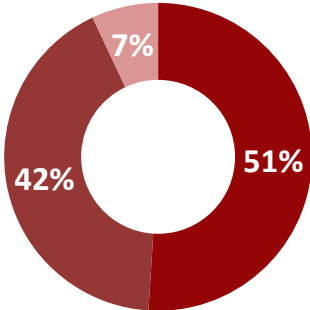


Note: Excludes general industrial of \$36M

# CIRCOR Aerospace & Defense

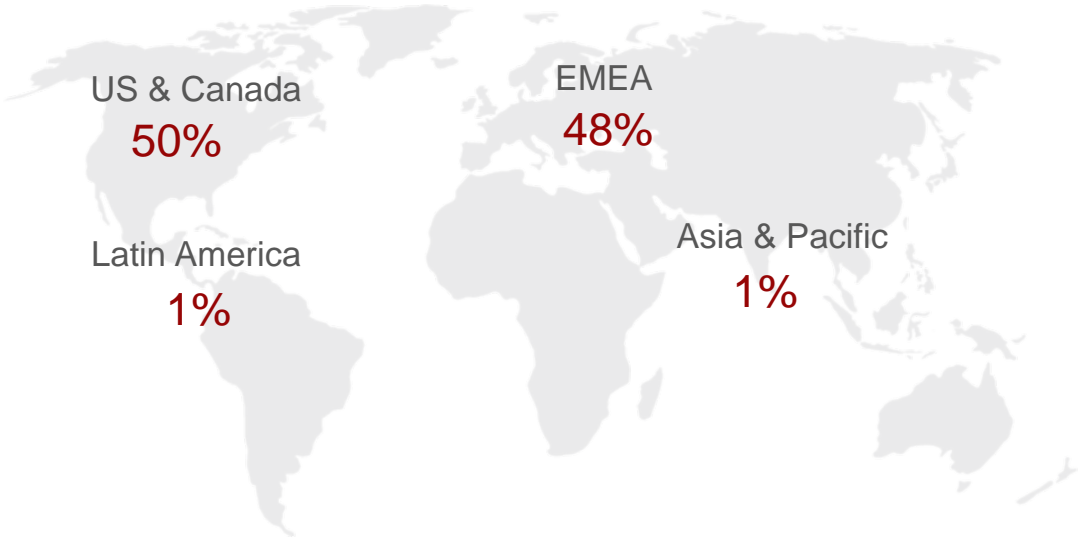
## Sales

Revenue by Segment



■ Commercial ■ Military ■ Other

Revenue by Region



•Significant opportunity to grow in Asia and South America

# Strong Brands with Differentiated Technology

## Brands



## Products



Long Range Bizjet  
Electro-Mechanical  
Actuation



UAV Nose Wheel  
Steering Actuation



Submarine Critical  
Air Control Valves



Narrowbody Tachometers



Widebody Landing  
Gear Door Actuation



# Aerospace & Defense Locations & Products

Facility Details	Actuation	Fluid Control
<p><b>California</b> Facility Size: 115,000 ft<sup>2</sup></p> 	<ul style="list-style-type: none"> <li>• Door Actuation</li> <li>• Motors</li> </ul>	<ul style="list-style-type: none"> <li>• Hydraulic Valves</li> <li>• Pneumatic Valves</li> </ul>
<p><b>Paris</b> Facility Size: 11,000 ft<sup>2</sup></p> 	<ul style="list-style-type: none"> <li>• Solenoids</li> <li>• Pressure Switches</li> <li>• Manifolds</li> </ul>	<ul style="list-style-type: none"> <li>• Hydraulic Valves</li> <li>• Couplings</li> </ul>
<p><b>Chemillé</b> Facility Size: 17,000 ft<sup>2</sup></p> 	<ul style="list-style-type: none"> <li>• Motors</li> <li>• Wheel Speed Transducers</li> </ul>	<ul style="list-style-type: none"> <li>• Hydraulic Valves</li> </ul>
<p><b>Morocco</b> Facility Size: 40,900 ft<sup>2</sup></p> 	<ul style="list-style-type: none"> <li>• Motor Winding</li> </ul>	<ul style="list-style-type: none"> <li>• Component Marching</li> </ul>
<p><b>New York</b> Facility Size: 31,000 ft<sup>2</sup></p> 	<ul style="list-style-type: none"> <li>• Switches</li> </ul>	<ul style="list-style-type: none"> <li>• Regulators</li> <li>• Power Modules</li> <li>• Centrifuges</li> </ul>
<p><b>Uxbridge</b> Facility Size: 48,380 ft<sup>2</sup></p> 		<ul style="list-style-type: none"> <li>• Regulators</li> <li>• Hydraulic Valves</li> <li>• Pneumatic Valves</li> </ul>

# CIRCOR Aerospace & Defense

Low Cost Manufacturing

## China – Suzhou

- Machining / Final Assembly / Test
- Local supply chain

## Morocco - Tangier

- Assembly & Test
- Machining
- Windings

## India – Coimbatore

(opened 2012)

- Engineering
- Sourcing
- Manufacturing



# CIRCOR Aerospace & Defense

## Major Programs



Airbus A350 XWB , A320, A330/340, A380  
Boeing Next Generation: 737, 747, 767 and 777



Gulfstream 650/Learjet 85/Hawker Beechcraft/Dassault 7X, 2000/ Cessna Citation  
BBJ / HondaJet / Embraer Phenom / Bombardier Global Express



T-38 / T-45 / F-15 / F-16 / F-18 / F-22 /F-35  
UAVs: Predator / Global Hawk / Fire Scout / A-160 Hummingbird



Weapons Programs: SM3 / AIM-7 & 9X / Hellfire / Longbow /  
Sea Sparrow / EKV (Exoatmospheric Kill Vehicle)



Augusta Westland 129 BCH Helicopter  
AH-64D  
Eurocopter EC-175 (Z-15)



Mitsubishi Regional Jet  
C-Series Bombardier Regional Jet



HMS Victorious V-Class SSBN Ballistic Submarine  
LCS USS Freedom

# CIRCOR Aerospace & Defense Products

Your Component & Sub-System Design Partner for  
Fluid Control and Actuation

## Engineered Products



Main Landing Gear Door  
Actuator



Norm Brake Selector  
Manifold



Cold Gas  
Thruster  
Regulator



Built-In  
Breathing  
Systems

## MRO Repair Station Products



Hydraulic Stick  
Pusher



Check & Relief Valves



Motor-Operated Valves



“Geared” Turbofan  
Fuel Solenoid  
Valves

# CIRCOR Aerospace & Defense

## Core Capability



### Fluidic Control

- Pneumatic, Fuel, Hydraulic
  - Commercial Transport, UAV, Missile/Defense
  - Sensing & flight control components commercial transport
  - Missile/Defense
- 

### Actuation

- Military, Commercial Transport, Bizjet, Rotorcraft
  - Variable electro-mechanical actuation with position feedback
- 

### New Products & Technologies

- Fit and enhance product portfolio
- Access to new customers and aftermarket
- Unique technologies: enhancements, increase value proposition

# Sample Defense Content



Nose-Wheel Steering Actuator



Instrumentation Pressurization Pod



Canopy Seal Regulators  
Fuel Valves  
Hydraulic Valves  
Pneumatic Valves  
Accumulator Pressure  
Gauges



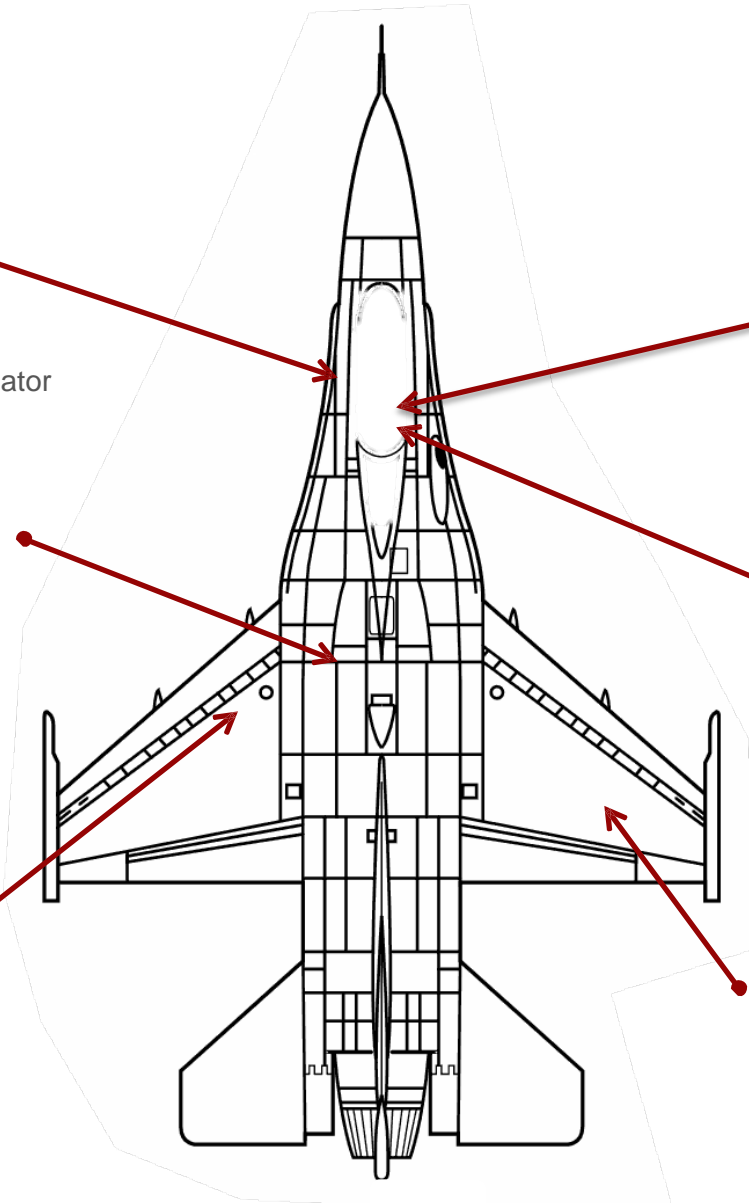
Helmet Visual Display  
Seat Potentiometer



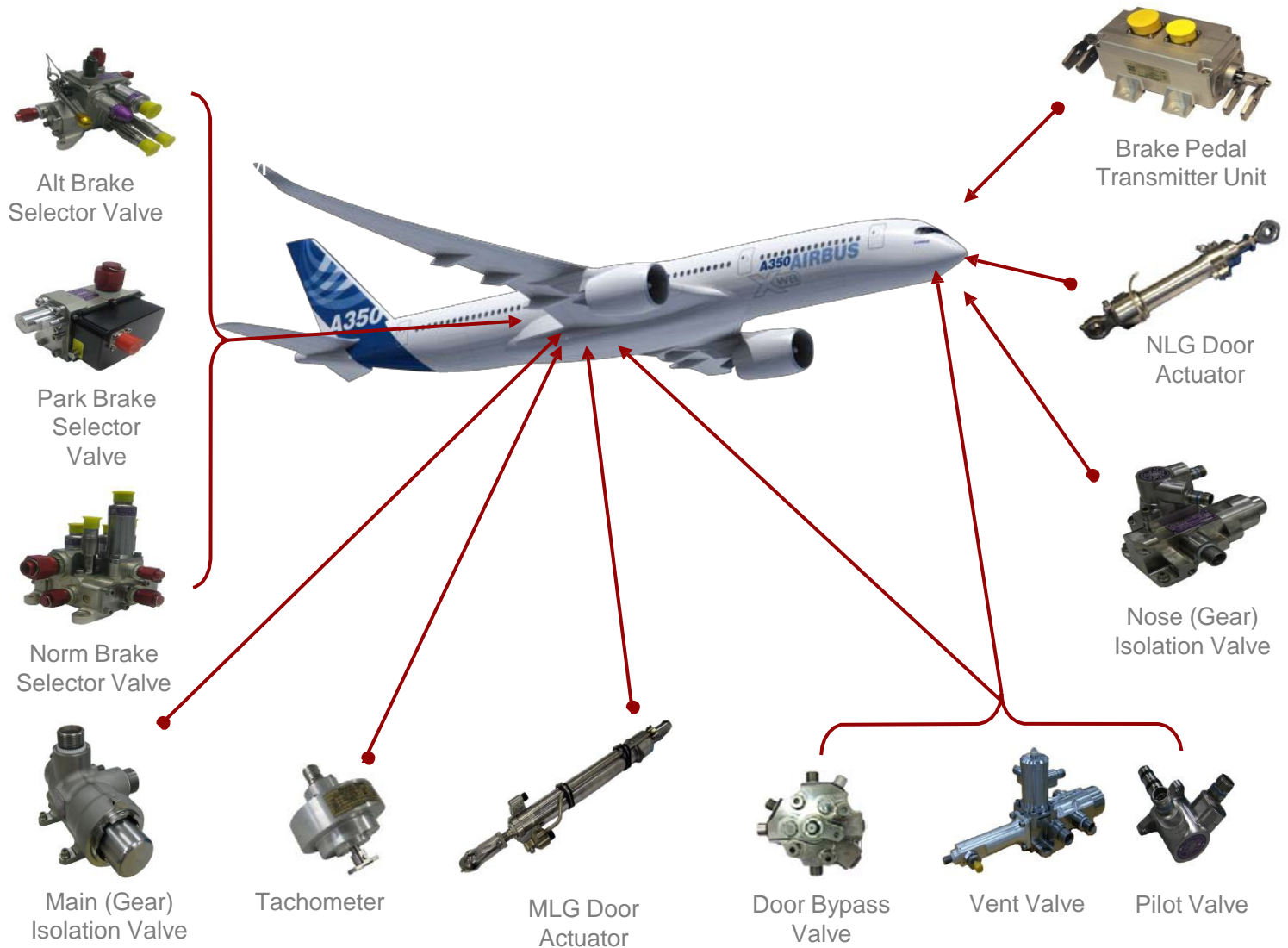
Brake  
Manifolds



Pneumatic Power Module



# Sample Commercial Content



Investor Day –  
CIRCOR Aerospace  
& Defense



# Actuation: Hydraulic Actuators

Hydraulic Actuator Pedigree			
Technology	First Generation	Current Products	Future Development
Actuator	- Build to Print	<ul style="list-style-type: none"> <li>- Design to Spec</li> <li>- Military, Business Jet to Large Air Transport applications</li> <li>- 3,000 psig and 5,000 psig operating pressures</li> <li>- Rate control and snubbing mechanisms</li> </ul>	<ul style="list-style-type: none"> <li>- Internal mechanical locking (extend and/or retract)</li> <li>- Lock Indication (proximity or micro-switch based)</li> </ul>



F-16 Nose Wheel Steering Actuator



A350 Main Landing Gear Door Actuator



A350 Nose Landing Gear Door Actuator

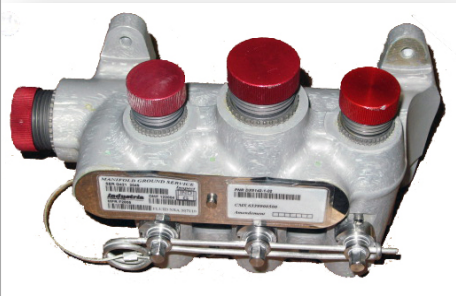
A330 Retract Actuator





# Fluid Controls: Manifolds

Valve Pedigree			
Valve Type	First Generation	Current Products	Future Development
Manifold Valve Assembly	- 1990's Ground service manifold,	- 2000's simple spool valve, pilot plug-in manifold	- Multi component integration, several spool assy with complex component



A340 Ground service Manifold



A400 Ground service Manifold



A350 Alternate Brake Selector Valve



AB139 Rotor Brake selector valve



# Fluid Controls: Motor Operated Valves

## Valve Pedigree

Valve Type	First Generation	Current Products	Future Development
Motor Operated Valves	<ul style="list-style-type: none"> <li>-1970's: developed valve only w/o actuator.</li> <li>-Designed/qualified MOV w/actuator in mid-70's.</li> <li>-1980's: qualified "Big-4" Boeing MOV.</li> </ul>	<ul style="list-style-type: none"> <li>-Permanent magnet motors for longer life.</li> <li>-Weight-saving designs.</li> <li>-Modular designs.</li> <li>-Acquired Motor Technology.</li> </ul>	<ul style="list-style-type: none"> <li>-CIRCOR brushless motors.</li> <li>-Composite materials.</li> <li>-Smart Valve Technology; variable open/close, flow control.</li> <li>-Electronic controller.</li> </ul>



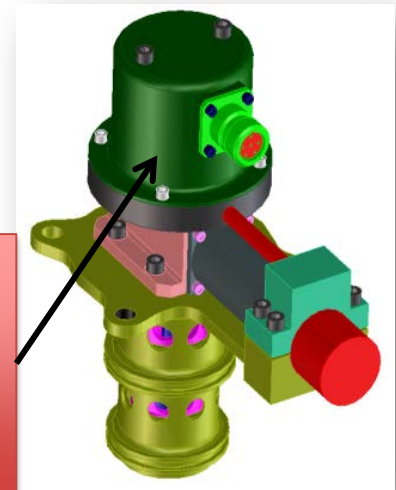
Standard LRU Actuator used on 4 separate Boeing valves

Unibody construction w/EMI filter and thermal relief valve

Boeing Hydraulic Shutoff Valve  
B737, 767, 777

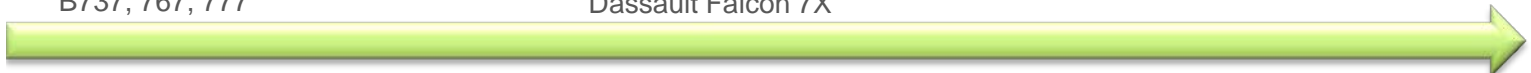


Parker Hydraulic Shutoff Valve  
Dassault Falcon 7X



Brushless motor, manifold interface, to replace a solenoid operated valve.

Sikorsky Gearbox Shutoff Valve S-92

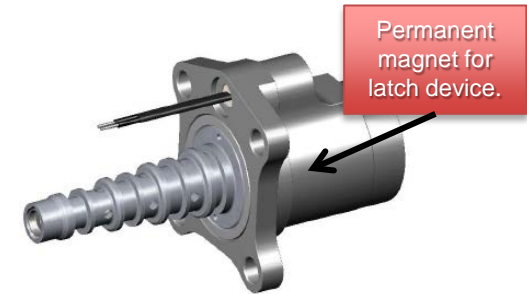


# Fluid Controls: Solenoid Valves

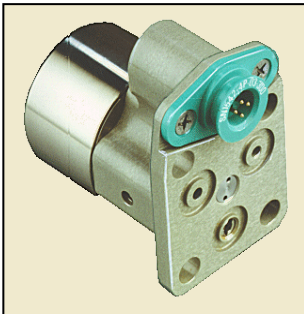
Valve Pedigree			
Valve Type	First Generation	Current Products	Future Development
Pilot Solenoid Valve	- 1970's - Developed valve from BTP product	- "Mini" solenoid valve - "stage noze" pilot valve	- Permanent magnet latch valve - Pick and hold/PWM device for power saving



A320 Braking Pilot Valve



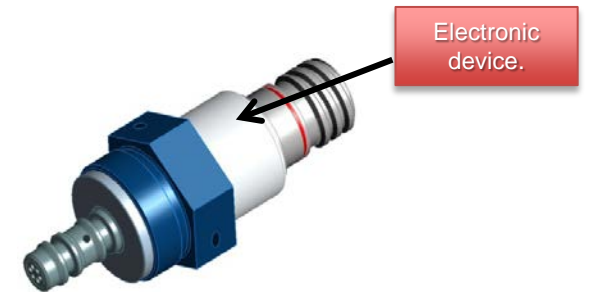
SYRENA, A350 Park brake valve



Airbus flight control (A320)



A350 LG Pilot Valve



# Electro-Mechanical Controls: Tachometers

Tachometer Pedigree			
Technology	First Generation	Current Products	Future Development
Variable reluctant flux	<ul style="list-style-type: none"> <li>- 1980's for Airbus Platforms A300, A320, ...</li> <li>- Dassault Business Jet</li> </ul> <p>Only one customer: Messier-Bugatti</p>	<ul style="list-style-type: none"> <li>- Business Jet to Large Air Transport applications</li> <li>- Military and civil business</li> <li>- Integration of TPIS function</li> </ul>	<ul style="list-style-type: none"> <li>- Small tachometer for small Business Jet (less than one inch)</li> <li>- Electronic Tachometer (TBC): measurement from 0 rpm, indication of direction</li> </ul>



**A320, A330-A340  
Tachometer**



**Rafale  
Tachometer**



**A380  
Tachometer**



**ARJ21  
Tachometer**



**F2000  
Tachometer**



**F7X  
Tachometer**



# Assemblies, Manifolds & Systems

The safe control & reduction of high pressure fluids to lower application pressures used on submarines & surface warships today



Built-In Breathing Systems



Bottle Head Assemblies

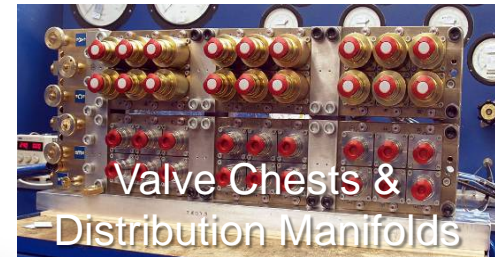


Reducing Stations & Manifolds

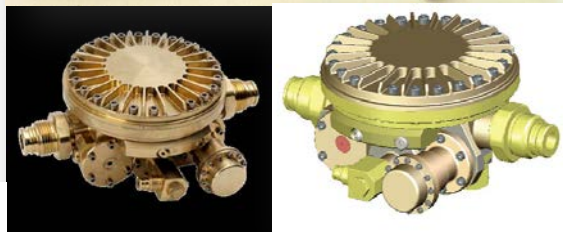


Hood Inflation Systems

Autocharge Systems:  
automated cylinder filling



Valve Chests & Distribution Manifolds



# Portable Charging Units

Ground service equipment serving business aviation, commercial and military aerospace.



# Supplying Industry Leaders



# Quality Attributes

- Quality Control Systems Implemented

- AS9100C
- NASA NHB5300.4
- FAA PMA FAR 21
- FAA FAR 145 Repair Station
- EASA 145 Repair Station
- Calibration ANSI/NCSL Z540-1



- Product Traceability

- Unique Traceability # of each lot
- UID Marking
- Full Documentation System

- Continuous Improvements

- Cross Functional Teams
- Kaizen Events / Model Lines
- Lean Sigma Systems
- CIRCOR Problem Solving



- Customer Satisfaction
- Lockheed Martin STAR Supplier
- Lockheed 100% Delivery & Quality Award
- Airbus SQIP Gold Award Winner
- Customer Approved Supplier
- Government
- Boeing D6-82479
- Airbus GRESS
- Rolls Royce SABRE
- NASA
- Lockheed Martin
- Honeywell Self Reliance
- Gulfstream
- Northrop Grumman
- Strategic Supplier Management
- On time delivery/ Quality monitoring and reporting





# Thank You



[www.circoraerospace.com](http://www.circoraerospace.com)